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ABSTRACT

This booklet examines the educational value of jigsaw puzzles and gives practical suggestions on how to select and make them for use by children ages 1 through 8. It asserts that jigsaw puzzles provide children with the opportunity to develop problem-solving strategies, and discusses a theory of adult-child interaction that encourages the development of such strategies. In addition to problem solving, the booklet discusses how jigsaw puzzles help children to learn about various mathematical concepts and to develop eye-hand coordination, visual discrimination, and social skills. Practical suggestions are given on how to purchase jigsaw puzzles and how to organize the jigsaw puzzle area. A number of techniques for making puzzles are offered. Jigsaw puzzles for special needs children are also discussed briefly. (AS)

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JIGSAW PUZZLES

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JIGSAW PUZZLES

By

Marilyn Fleer

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INTRODUCTION

Jigsaw puzzles are used in most child care centres, preschools and schools. If the puzzles are carefully selected they can provide a wealth of mathematical, social and fine motor development for children.

This booklet is intended to offer not only practical suggestions of how to set up and maintain a stimulating jigsaw puzzle area, but also to discuss a theory of adult-child interaction which will encourage the development of problem solving strategies among young children.

THE EDUCATIONAL VALUE OF JIGSAW PUZZLES

Jigsaw puzzles provide young children with many different opportunities for learning, such as visual discrimination, eye-hand co-ordination, social development, and the development of specific mathematical concepts. However, central to the skills gained by children from working with puzzles is the development of problem solving strategies.

It is now recognised that problem solving is an essential factor in not only all areas of the curriculum but as an important life skill. It is important for young children to have and continue to develop effective problem solving strategies. Jigsaw puzzles provide children with the opportunity to develop problem solving strategies.

Adult intervention is needed if children are to gain the maximum benefit from their experiences with puzzles. For this to occur, an understanding of problem solving and the adult's role in helping children to develop problem solving skills is required. A brief discussion of problem solving and how children can be assisted with the development of problem solving skills follows.

PROBLEM SOLVING WITH JIGSAW PUZZLES

A problem is simply any situation in which the individual does not easily see a solution or technique for tackling the event or experience. A jigsaw puzzle can be classified as a problem when no apparent formula can be applied directly to the completion of the puzzle.

When children try to solve jigsaw puzzles they experience a variety of problem solving situations, as each puzzle sets a different challenge. Prior problem solving skills may at times be directly applicable to new jigsaw puzzles. However, different and more sophisticated techniques will need to be developed if a child wishes to complete the variety of puzzles available. A problem for one individual may only be seen as a task or simple exercise later in that child's development. Puzzles which may be initially difficult for a particular child may not be a challenge after continued opportunities for problem solving through puzzle work. In addition, what is seen as a problem for one child is not necessarily a problem to another. In a group of four year olds engaged in puzzle solving, not all children will be able to competently solve each puzzle. For example, one puzzle which may be a challenge for some children, may be a quick and easy task for others.

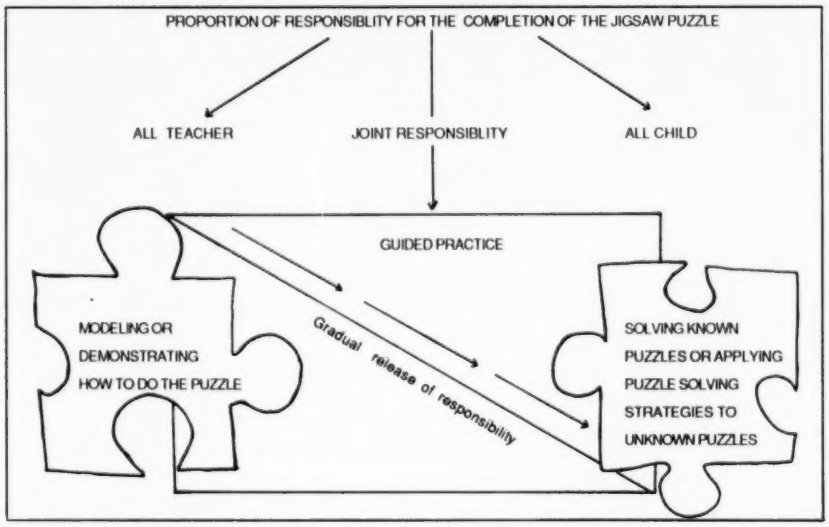
The immediate difficulties experienced by children when working on a puzzle will only be a problem if the child wants to solve the jigsaw. If the child is not motivated to attempt the puzzle then it will not be a problem, since the child will not engage in the activity. Motivation is a key aspect in the commencement and continuation of problem solving.

For children to successfully problem solve they need to be given more than just an opportunity to do puzzles. Children need to be encouraged to develop strategies which can be effectively applied to a range of problem situations.

ASSISTING CHILDREN TO DEVELOP PROBLEM SOLVING SKILLS

When problem solving is considered within the jigsaw puzzle context a number of strategies can be used to assist children. The strategies used by staff to encourage problem solving skills among young children may be developed through a technique known as *scaffolding*.

This metaphorical term was first introduced by Bruner (1983) and his colleagues. It refers to a social situation in which the adult and the child share responsibility for completing the particular problem. The child engages in all aspects of the problem that he/she is capable of and the adult assists with the rest. In this way practice of difficult aspects of the task are executed with the full support and modeling of the adult. The adult will gradually hand over more responsibility as the child becomes increasingly proficient. A model of this process is shown below.



MODIFIED FROM: Basic structure of learning environments that fit the term *Scaffold* (J.Campione, in Pearson and Gallagher, 1983).

In puzzle solving there are a number of common strategies which can be developed through scaffolding. They include:

- Discussing the puzzle picture before it is dismantled.
- Turning all the pieces face-up so that the design of the picture is clearly presented.
- Talking about the particular part of the puzzle that may be missing, for example the arm from a body puzzle - the reverse also, examining the puzzle piece and discussing what it looks like and represents in the puzzle.
- Discussing the colour, patterning or shape of the border, and asking the child to look for a piece with those characteristics.
- Examining puzzle pieces already inserted and discussing the colours of particular areas and asking the child to look for a piece with that colouring or patterning.
- Examining puzzle pieces already inserted and discussing the shape of the gaps that are left and looking for pieces that resemble that shape.
- Asking the child to try and rotate the puzzle piece into position. If this is unsuccessful, then gently move the piece so that it will be placed into position, instead of being forced.

- Inserting a puzzle piece that may be causing difficulties because of its dependence in the placing of the remaining pieces - verbalising exactly what you are doing and why you are placing it into that particular location.

- Discretely moving appropriate puzzle pieces closer to the child's reach, so that it may be selected next for placement. This is a useful strategy when the child is becoming frustrated.

- Modeling to the child puzzle solving through verbalising thinking and problem solving strategies used (particularly those discussed above).

SPECIFIC MATHEMATICAL CONCEPTS

In addition to problem solving which is inherent in all jigsaw puzzles, children also learn about various specific mathematical concepts when they engage in puzzle solving. The specific concept developed will largely depend upon the type of puzzle and the particular design. In this section, specific concepts and skills are discussed in relation to a number of puzzle types and designs.

Young children engage in mathematical thinking long before they attend child care or preschool. They have already explored their own personal space and have developed concepts of, for example, *proximity, order, measurement* and *number.*

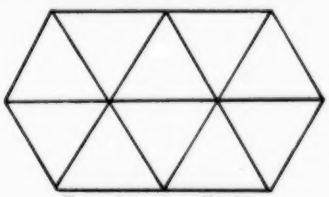
Proximity of objects means an understanding of objects that are near to them and those that are far. For example young children will know that their toes are close to their legs, but that their grandparents live far away. In puzzle solving, this concept is further developed through experiences with manipulating puzzle pieces and discussing their relationship with each other. For example the language associated with the location of puzzle pieces may include (Cruikshank and Sheffield, 1988:10):

here	there	inside	on top of	(next to)
up	down	outside	in the box	(near)
over	under	above	below	(along side of)

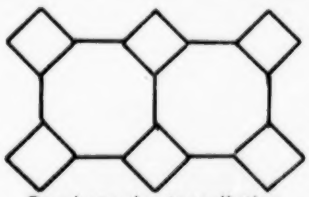
Space and geometry

Geometry is mathematics that is concerned with position or location in space (Burton, 1985). Puzzle solving allows children to informally explore concepts such as *patterns, symmetry, boundary, position, reflection, scale, rotation,* and *tessellations.*

Some puzzles are specifically constructed for children to either duplicate or create patterns, some of which are more complex and require children to be able to repeatedly fit a regular shape such as a triangle into a border to completely fill in the specified puzzle area. This is termed a *regular tessellation* and is shown below. *Semi-regular tessellations* require children to repeatedly fit two different shapes together into a specified area. The pattern formed is similar to bathroom tiles.



Regular tessellation



Semi-regular tessellation

Some puzzles require children to look carefully for clues in the position or direction of the pictures in the design of the puzzle. Others focus on the congruence of pieces for example some pictures are mirror images of each other, while others present a range of shapes such as a square, pentagon, rhombus and circle.

It is through the movement of objects in a defined space (rather than learning to label particular shapes such as a triangle), which helps children to learn about the particular attributes of shapes. Puzzles can generally be considered 2-D, however many 3-D puzzles are now available for children to solve.

All these facets of spatial relations lay the foundation for important mathematical concepts of space.

Measurement

The concept of measurement encompasses length, time, area, volume, capacity, weight, mass, temperature, angle, etc.; only the first three are considered in puzzle solving. For a child to understand the concept of measurement she/he needs to believe in the constancy of the measuring unit under changes of position. For example, if a pop stick is used to measure the length of a child's leg, the child needs to understand that the pop stick (unit) will have the same value when it is used to measure the child's arm. For this concept to develop many free play and directed activities are needed.

An understanding of *size* further assists children with their puzzle solving, since they need to consider the specific size of pieces in order to place them correctly. Words or phrases and the corresponding concepts that are developed through puzzle solving, may include (Cruikshank and Sheffield, 1988: 10):

big	little	tall	bigger than
short	biggest	wide	smaller than
thin	fat	long	fatter than

This informal language and concept development forms the foundation to a firm understanding of length as a attribute of measurement.

Time

Order is another spatial relationship which children need to understand if their thinking skills are to be further developed. Children experience events and routines in their lives which can be portrayed in jigsaw puzzles. Through puzzles which allow children to order specific events by manipulating cards or puzzle pieces with various time sequences, children will develop an understanding of time.

The following list of words and phrases illustrates the language which is emphasised in such sequencing experiences (Cruikshank and Sheffield, 1988:11):

before	now	spring	when the bell rings
after	later	winter	when it gets warmer
yesterday	tomorrow	last winter	when it gets colder
(dinner time)	(birthday)	(bed time)	(days of the week)

Area

Through the process of assembling puzzles, children begin to develop an understanding of the concept of area. They begin to appreciate that area is the amount of space enclosed by a boundary. Later they will begin to understand that a common unit is needed if comparisons between particular areas are to be made. This will lead to an understanding of a standard unit of measure for area (metric units). However, at each stage of this continuum children need to explore and make discoveries that will lead them to a concept of area. Puzzle solving is one activity that can lead to this concept attainment.

Number

Number is a difficult concept for children to understand, since there is nothing inherent in, for example, the number 3 that indicates that it represents three objects. Some puzzles use numerical symbols as part of their picture design. These puzzles either have the numbers cut as individual pieces, or the whole puzzle is cut across number symbols.

In either case children are focusing on the specific characteristics of the number symbol and familiarising themselves with how each number looks. When this is combined with an adult or more competent peer who articulates the name of each number it is possible for further concept development to take place. Other puzzles encourage children to discuss or count items contained in the picture, for example a series of trees may be presented with different numbers of apples on each tree, or a rocket puzzle may have the numerals from ten to zero painted down the side.

Seriation puzzles such as trees of varying sizes, also allow for the further development of mathematical skills which will lead to an understanding of ordinal number (first, second, third etc.).

VISUAL PERCEPTION

Visual perception is inherent in most aspects of puzzle solving. The visual image of the piece to be placed or the space to be filled are often augmented by feel. The child will both see and feel the difference between a curved and a straight edged puzzle piece.

Newborn infants have been shown to be able to discriminate between many different shapes, colours and patterns. During the preschool years children learn to use this information in a conscious way, to deliberately search for visual clues when solving problems, and to gradually make much finer discriminations. These are all abilities that will be required for reading, writing, and making detailed observations of the world around them as adults.

Graded jigsaw puzzles allow children to further develop their visual discrimination skills. Simple puzzles require discrimination of large differences, using one dimension only, for example shape. The more difficult the puzzle, the greater number of dimensions of discrimination that are used in solving the puzzle. Children will learn to notice not only shape, but pattern and colour when putting together puzzles. In the most difficult puzzles, those of 1000 pieces or more, very fine discriminations are required between gradations of colour and shape. Even adults find visual discriminations of this order difficult without practice.

Children may need some help in the intermediate stages of puzzle solving in learning how to extract information from the range of visual cues presented in a given puzzle. Suggestions for such guidance have been outlined earlier.

EYE-HAND CO-ORDINATION

The physical act of puzzle solving requires the child to engage in fine motor skills and a high level of eye-hand co-ordination. A one year old child would have a lot of difficulty attempting to physically manipulate a ten piece jigsaw puzzle with sufficent competence to move the pieces into place (even if she/he were at a cognitively high enough level to do it).

Puzzles with nobs greatly assist children's ability to physically manipulate pieces. More difficult puzzles have usually more pieces of smaller size. Whilst this is designed to challenge the more able on a cognitive level, it also ensures that younger children with less developed fine-motor skills are handling larger puzzle pieces. The increase in puzzle pieces corresponds generally with a decrease in the size of each piece, thus gradually allowing the child to develop finer motor control and better eye-hand co-ordination.

Encouraging children to engage in puzzle solving is a useful activity for the development of fine motor skills and eye-hand co-ordination. The following section may be a useful guideline for selecting puzzles for use with particular age groups (this categorisation will vary depending upon the child's prior experience with puzzle solving).

1-2 year olds: puzzles with nobs; puzzles with complete inserts; pieces are visibly different (e.g. cat; human; house).

2-3 year olds: puzzles with nobs; puzzles with complete inserts; some easily defined seriation puzzles; simple pictures with whole segments as inserts (e.g. roof of a house; base of the house); some puzzles with four easily definable pieces.

3-4 year olds: some puzzles with nobs; puzzles with many pieces (4-10); simple 3-D puzzles; simple floor puzzles.

4-5 year olds: seriation puzzles (only fine discriminations); a variety of seriation puzzles; puzzles with and without borders; puzzles with many pieces (10-20); a range of 3-D puzzles; some tessellating puzzles (see maths section for details); a variety of floor puzzles; layered puzzles; sequencing puzzles; standing puzzles.

5-8 year olds: as for the 4-5 year olds but increasing the number of puzzle pieces.

SOCIAL DEVELOPMENT

Children's social development may be reflected in how they engage in puzzle solving. Parten (1932) categorised children's play into five distinct areas, they include: solitary play; onlooker play; parallel play; associative play; and co-operative play. These particular categorisations can be clearly seen when children actively solve puzzles.

At the age of three or four many children engage in parallel play whereby they play in similar ways with similar toys but do not interact. This can be depicted in their puzzle solving since many children will solve puzzles side by side. Attempts by more socially developed children to assist will often result in the child watching as the intruder completes the puzzle or walking away and attempting another puzzle alone.

Co-operative play can be seen in children of four and five and is evident in their desire to assist each other with the completion of puzzles. Children will request or offer assistance at this stage of their social development. Children will discuss the content of the puzzle, the difficulty they are having in fitting a piece and will take joint pride in the completion of the puzzle often drawing other children's attention to their efforts and success.

At this stage of their development young children will learn many problem solving techniques from each other. In addition, they will further develop their social skills as they jointly solve puzzles.

Social development may be specifically planned for through an understanding of each child's particular level of development. The following section may offer some guidance.

1-2 year olds
Sit with the child and model how to solve the particular puzzle. Then encourage the child to complete the puzzle with your guidance (using the techniques discussed earlier).

2-3 year olds
Work individually with this age group, but allow the child to complete the puzzle with your guidance (using the techniques discussed earlier).

3-4 year olds
Begin encouraging the child to work with another child to solve puzzles. Work with two or three children on solving puzzles, particularly floor puzzles. Ask children to help each other in completing puzzles.

4-5 year olds
Continue to assist individuals, but where possible encourage children to work together in puzzle solving.

5-8 year olds
Introduce difficult puzzles or rules that require children to work co-operatively in puzzle solving.

SELECTING JIGSAW PUZZLES

The range of puzzles selected for placement at any time in the puzzle area is of utmost importance. The selection of jigsaw puzzles from those available in a centre needs to be reviewed so that future purchases (to replace or add to the existing stock) can be made from an informed position.

In purchasing jigsaw puzzles or reviewing the existing puzzle stock there are a number of factors to consider. These include the difficulty level, the particular type of puzzle, the appropriateness of the picture, the accuracy of information displayed and the durability of the puzzle.

HOW TO PREDICT THE DIFFICULTY OF A JIGSAW PUZZLE

It is most important that you attempt the puzzle yourself. Without doing so it is hard to determine the *type* and *combination* of 'difficulty factors' that have been considered in the design of the puzzle. The types of factors that may be incorporated include:

- The number of dependent pieces (this relates to the number of puzzle pieces that are dependent on the prior placement of another piece).
- The number of pieces in the puzzle.
- How the puzzle is cut.
- The familiarity of the picture on the puzzle.
- The complexity and clarity of the picture or pattern on the puzzle.

In planning for the introduction of puzzles for a specific group of children, it is useful to consider the graduations in 'difficulty level' that can occur. An example of this is listed below.

THE RANGE OF DIFFICULTY LEVELS IN JIGSAW PUZZLES

(A4 size or smaller only):

- Lift out pieces with nobs.
- Discrete pieces framed within a simple outline (e.g. body).
- Discrete pieces with some unconnected pieces within a simple outline (e.g. rocket).
- Unconnected pieces with colour and shape matchings to border (6 pieces).
- Increasing the number of pieces from 6 to 12 with breaks through major parts or colours in the picture.
- Colour and shape definitions on border becoming more obscure.
- Breaks between puzzle pieces to be less reliant on the shape and colours in the picture.
- Introducing dependent pieces (i.e. those dependent on prior placement of another piece).
- Introduction of shape related puzzle shapes (e.g. different sized triangles).
- Shapes that fit into one another (zoo puzzles).

It may be useful when initially introducing shape related puzzles to include a paper outline of the shapes at the bottom of the frame until the skill is mastered.

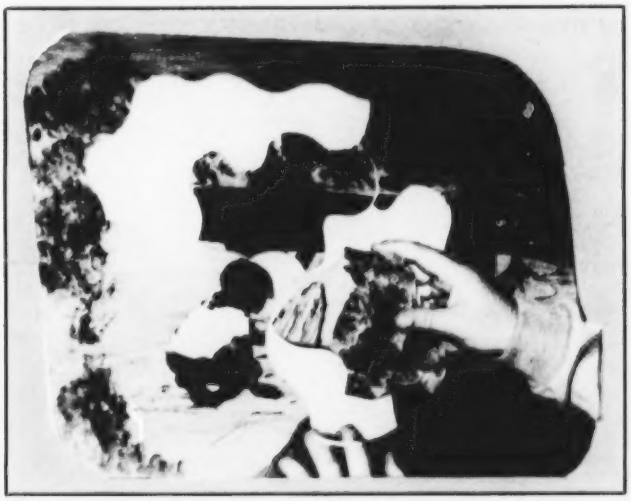
A variety of puzzle types are available and would provide not only variety but challenge to the young puzzle solver. The different types of jigsaw puzzles include:

Puzzles with nobs
Puzzles with borders
Puzzles without borders
Floor puzzles
Sequencing puzzles
Seriation puzzles
Layered puzzles
Standing puzzles
Three dimensional puzzles

THE APPROPRIATENESS OF THE PICTURE PUZZLE

It is not only the type or difficulty level of the puzzle that needs to be considered when selecting puzzles, but the appropriateness of the picture on the puzzle (particularly when purchasing). Staff need to be aware of:

1. Demonstrating Australia's multicultural society.
2. People doing things that are representative of today (avoid stereotypes).
3. A balance of male and female characters.
4. Representing the unique aspects of Australia e.g. Australian Animals.
5. Representing familiar experiences.
6. Some puzzles are difficult to buy e.g. Aboriginal puzzles - consider making these.



Multicultural Australia

- Does the picture represent the multicultural group of children attending the centre?
- Do the illustrations for example accurately reflect Aboriginal children?
- In the overall range of puzzles available at the centre are there sufficient multicultural children depicted in the illustrations on the puzzles?

The particular group of children represented need to be shown doing every day things and not just represented in stereotypical roles, for example Aboriginal people involved in common tasks such as shopping rather than just images of Aboriginals involved in a corroboree. In the collection of puzzles available in a centre, it is important to have some puzzles which show cultural aspects of a particular group, but it would certainly be inappropriate to have all puzzle pictures of that particular cultural group illustrated in that way.

Gender-biased puzzles

It is particularly important to have a range of puzzles that appeal to both boys and girls. The puzzles available at any one time should include a balance between mechanical and people images (cars, boats, rockets, gardening scenes, family, children dancing).

Puzzles with people on them should reflect a balance between male and female characters. In addition the scenes should reflect males and females in both nurturing and active roles such as fixing

a car or feeding a baby. Females should not always be shown in subservient stereotypical roles such as sweeping the floor or doing the dishes. It is important for boys to be shown in these roles, as it is important for girls to be shown doing tasks such as chopping the wood or repairing a bicycle.

Boys and girls need to be shown in both passive and active roles. Having puzzles which show girls in passive roles and boys in active roles, such as a girl holding a doll and a boy kicking a ball, should be avoided. Careful examination of the puzzles available in the centre for a predominance of girls in passive roles such as looking on whilst boys perform the task should be considered prior to the purchase or construction of new puzzles. Any imbalances can then be determined and future purchases can ensure that this imbalance is rectified.

Australian-based content

Australia has many unique flora and fauna, many interesting landmarks and certainly an identity of its own that should be reflected in the content of the jigsaw puzzles. Whilst 'zoo' animals for example, are still of interest to young children, adults can further extend the children's understanding of their own surroundings through the introduction of content that is typically Australian.

Through familiar content on the puzzle such as a photographic image of the local community, children are more likely to be motivated to attempt solving the puzzle. For example, those children who do not use the puzzle corner frequently may become attracted to this area, since the content they are working with is known.

ORGANISING THE JIGSAW PUZZLE AREA

Many factors need to be considered in designing and maintaining a jigsaw puzzle area.

1. Changing the puzzles regularly.
2. Re-introducing 'old favourites'.
3. Providing a range of puzzles that will cater for the least able to the most competent problem solver.
4. Providing sufficient floor space or table area.
5. A display area that is attractive, uncluttered and well lit.
6. Ensuring that the flow of traffic is not within or near the puzzle area.
7. Encouraging children to complete a chosen puzzle and return it to the shelf.
8. Encouraging staff to spend time in the puzzle area assisting children with puzzles.
9. Having on average a minimum of ten and a maximum of twenty puzzles available (dependent upon space available and number of children in the group).
10. Considering the types and suitability of puzzles for the particular group of children (discussed earlier).
11. Using only puzzles that have all their pieces.
12. Occasionally moving the puzzle area to different locations in the building.
13. Encouraging peer assistance with puzzle solving.
14. Having the puzzle area away from highly active areas that may cause distractions in concentration, for example the home-corner.

CHANGING THE PUZZLES REGULARLY

In selecting jigsaws for the puzzle area care must be taken to cater not only for variety, but also to ensure that sufficient of the 'old favourites' are available. This balance is difficult given the need to regularly change the range of puzzles available for the children.

Children need to be given the opportunity to re-do puzzles. This not only provides a great deal of satisfaction, but consolidates their problem-solving skills. In addition, children who were unable to

solve a popular puzzle when it was first introduced (due perhaps to their limited skills at the time) welcome the re-introduction of such a puzzle at a later date when their skills have developed.

PROVIDING A RANGE OF PUZZLES THAT WILL CATER FOR THE LEAST ABLE TO THE MOST COMPETENT PROBLEM SOLVER.

So that all children are able to engage in puzzle solving at their particular level it is important to have a range of puzzles available. More capable children need to be told which are the most challenging puzzles on the shelf, for example 'I have looked in my cupboard and have found a tricky puzzle for you Simone, I wonder if you will be able to do it?'. This ensures that they are aware that they are being catered for and will encourage them to look for and attempt challenging puzzles.

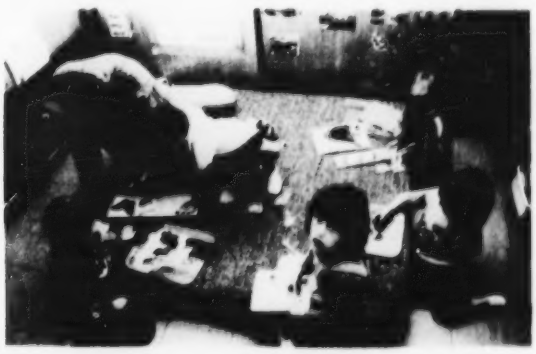
Likewise it is particularly important to indicate which puzzles are most suitable for the less able puzzle solvers, for example 'I have found some special puzzles over here that are for you to try, I wonder if I can trick you with them?'. This does not mean that the less able children are excluded from attempting difficult puzzles, it merely ensures that when working on their own, they will not be frustrated in attempting puzzles that are too difficult. These children should be encouraged to ask other children for assistance. Indeed all children should be encouraged to work together, since this allows individuals to see different techniques in puzzle solving, as well as further developing their social skills.

PLANNING THE JIGSAW PUZZLE SPACE

The space made available for working on puzzles will influence the quality of problem solving as well as the number of children who will engage in this activity and how often they will return.

Floor or table space

In planning for the provision of this area consideration should be given to the differences in a preference for the use of either the floor or a table for laying out the puzzle. In the former children are more likely to assist each other, as they can more easily crouch around and reach the puzzle. In the latter this is somewhat more difficult to do. The table space can restrict the area in use, particularly if it is shared by other children. However, using the floor has the disadvantage of pieces from different puzzles becoming more easily mixed up, resulting in great confusion and frustration for the children. In addition, it is more likely that the puzzle pieces may be trodden on, or accidently kicked under furniture as children walk between incomplete puzzles.



The display area

An attractive display area will entice children to want to work in that area. When puzzles are spaced apart on the shelf giving an organised rather than a cluttered appearance more children are likely to engage in puzzle solving. This organised puzzle area can be maintained by encouraging children to

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return completed or incomplete puzzles to the shelf after use. During 'pack-away' time or after a session of preschool, or at the end of the day in a child care centre, these puzzles can be completed so that the area always remains appealing to children.

JIGSAW PUZZLES FOR SPECIAL NEEDS CHILDREN

The introduction of computer technology has made available a valuable tool for education, particularly for special needs children.
Children with a physical handicap have often been excluded from intricate fine-motor tasks like jigsaw puzzle solving. With a microcomputer and a concept keyboard physically disabled children are able to complete jigsaws.

Since micro-computers are becoming more accessible consideration needs to be given to the previewing and purchasing of software that allows special needs children to also engage in puzzle solving.

HOW TO MAKE YOUR OWN JIGSAW PUZZLES

Jigsaw puzzles are expensive to purchase, but are rather inexpensive to make. Most home made jigsaw puzzles will only cost approximately one tenth of their purchasing price (wholesale). Making your own jigsaw puzzles ensures that a centre will have a range of puzzles that reflect the interest and needs of the users.

A half day workshop with a minimum of five people will yield approximately 20 puzzles (depending upon technique, energy and skill). All that is required are the basic materials listed below, plenty of tea and coffee, carefully selected designs and some enthusiastic people to put their talents to work.

There are a number of different techniques for making puzzles. The quickest form is when photographs or magazine pictures are used. The most effective and durable are those that are painted and varnished. The range of varieties are presented below:

The different methods of making puzzles

- painted
- laminated
- spray adhesive method
- water and glue method

- with borders
- without borders
- with stands
- 2-D or 3-D puzzles

- seriation puzzles (e.g. smallest to largest figures)
- complete cut outs and inserts
- sequencing puzzles (e.g. getting dressed pictures to sequence)
- floor puzzles

Important points to remember in the selection of the picture/design:

- Appropriateness of the picture/design (discussed earlier).
- Aesthetics of the design - choose open, non-fussy pictures which take up most of the board.
- Filled in backgrounds are not necessary.
- Children's colouring books and some sewing transfers are good sources of pictures.

Puzzle pointers:

- A combination of wood and card is not as durable as using two pieces of wood but it is less expensive and works just as effectively.
- Cardboard puzzles can be made of varying sizes and used on tables instead of floors. Large stimulus pictures make attractive puzzles. Photographs of the children who will be using the puzzles make appealing jigsaw puzzles.
- Puzzles do not have to be rectangular or square. Try other sizes and shapes - circular, long and narrow, any shape.

Materials and tools required for all methods:

- 2 pieces of 3 ply wood or chipboard for each puzzle
- Aquadhere or woodlock glue
- Sandpaper
- Sanding sealer
- Electric jig saw or band saw (the narrower the blade the finer cutting circle)
- Suitable pictures from calendars, wrapping paper, magazines, advertisements, etc. (not needed for painted picture technique).

Additional requirements:

• Painted picture technique:	acrylic paint (primary colours): paint brushes.
• Laminating technique:	laminator; photographic film or laminating film.
• Spray adhesive technique:	adhesive spray; clear contact.
• Water and glue technique:	varnish; spray varnish or clear contact.

PAINTED PICTURE TECHNIQUE

Step 1. Choose two pieces of wood the same size for the puzzle itself and the base.

Step 2. Prepare board for painting by either:
(a) painting with a sanding sealer or
(b) painting with aquadhere.
When dry lightly sandpaper (sanding sealer needs turps or kero to remove it from brushes. Then wash in soapy water, rinse well and dry).

Step 3. Apply design to prepared board by either:
(a) Drawing the picture on to the board with a soft pencil.
(b) Tracing the picture using carbon paper.

Step 4. Paint your picture.
Acrylic water based paints are suitable for puzzle painting because of their availability and ease of use. Acrylic water based paints are available in most child care centres, pre-schools and schools.

Step 5. Pictures are ready to varnish as soon as they are dry.
Any varnish can be used. Estapol clear, gloss or satin, is satisfactory. Allow to dry at least 8 hours before cutting. One coat can be sufficient but if more is needed, lightly sand surface, with the grain of the wood between coats.
Clean brushes with kero or terps. Then wash with soap and water, and stand on end to dry.
If spray varnish is to be used, then this can be applied after the puzle is cut and mounted.

Step 6. Decide on pattern for cutting (consider desired difficulty level). Cut into pieces.

Step 7. Lightly sandpaper all rough edges.

Step 8. Glue border to backing board with aquadhere or woodlock glue. Put under a weight to ensure a good bonding. Wipe off any surplus glue first.

Step 9. Fit puzzle pieces in. All complete.

LAMINATING TECHNIQUE

Step 1. Cut the picture and the photographic film to exactly the same size as the board. Attach corners with durex tape or laminating iron.

Step 2. Place in laminator for 3-5 minutes - till picture is firmly attached.

Step 3. Cut laminating film slightly larger than the size required and laminate again for the same period of time.

Step 4. Trim edges.

Step 5. With a jig saw or band saw cut a border 2-3 cm all around the edge (optional).

Step 6. Decide on a pattern for cutting (consider desired difficulty level). Cut into pieces.

Step 7. Lightly sandpaper all rough edges.

Step 8. Glue border to backing board with aquadhere or woodlock glue. Put under a weight to ensure a good bonding. Wipe off any surplus glue first.

Step 9. Fit puzzle pieces in. All complete.

SPRAY ADHESIVE TECHNIQUE

Step 1. Choose two boards the same size. Prepare one with sanding sealer or slightly diluted solution of aquadhere.
When dry lightly sandpaper (sanding sealer needs turps or kero to remove it from brushes. Then wash in soapy water, rinse well and dry).

Step 2. Cut out picture to same size or slightly bigger than the chosen board.

Step 3. Spray reverse side of picture and prepared board with spray adhesive. Carefully place sprayed surfaces together (from one edge of the board to the other pressing out air bubbles as you go). Dub over picture firmly and set to dry.

Step 4. When dry (allow) 24 hours if possible, if not some time after bonding) either:
(a) spray with a varnish evenly and let dry or
(b) cut a piece of clear contact bigger than your board. Fix over the picture using a straight edge of ruler, or dowelling, to smooth surface on.

Step 5. Turn puzzle board face down on to a good surfaced cutting board or cardboard, and with a trimming tool, cut surplus papers back to board edge.

Step 6. With a jig saw or band saw cut a border 2-3 cm all around the edge (optional).

Step 7. Decide on a pattern for cutting (consider desired difficulty level). Cut into pieces.

Step 8. Lightly sandpaper all rough edges.

Step 9. Glue border to backing board with aquadhere or woodlock glue. Put under a weight to ensure a good bonding. Wipe off any surplus glue first.

Step 10. Fit puzzle pieces in. All complete.

WATER AND GLUE TECHNIQUE

Step 1. Prepare board with slightly diluted aquadhere.

Step 2. When prepared board is completely dry, give it another coat of straight aquadhere.

Step 3. Immerse picture totally in a bath or basin of water until soaked.

Step 4. Remove the picture from the bath holding it up by two corners.

Step 5. Shake off surplus water and place on to board.

Step 6. With squeegee (or your hand) smooth firmly over board to remove any bubbles or high spots of glue.

Step 7. Set to dry thoroughly.

Step 8. Contact or varnish by brush or spray as required.

Step 9. With a jig saw or band saw cut a border 2-3 cm all around the edge (optional).

Step 10. Decide on a pattern for cutting (consider desired difficulty level). Cut into pieces.

Step 11. Lightly sandpaper all rough edges.

Step 12. Glue border to backing board with aquadhere or woodlock glue. Put under a weight to ensure a good bonding. Wipe off any surplus glue first.

Step 13. Fit puzzle pieces in. All complete.

Practice this method with all types of paper to find out which are most suitable. This method can be used to glue pictures on to thick cardboard as well.

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